KEYHOLE APPROACHES IN NEUROSURGERY pdf

1: Keyhole Brain&Spine

Technological progress in neurosurgery - preoperative investigation of the exact anatomy of the patient, detailed planning of the procedure, and use of endoscopes and videosurgery - have made approaches for intracranial microsurgical procedures smaller compared to historically standard neurosurgical approaches.

Transcranial decompression of the ipsilateral optic nerve is a well-described surgical step during surgeries for pathologies involving the optic canals. Recently a minimally invasive supraorbital keyhole craniotomy approach to the optic nerve has been demonstrated in a cadaver, again to reach the ipsilateral nerve with exposure primarily of the superolateral aspect of the nerve and canal. Several approaches to the medial nerve, canal, and tract have been described using a transcranial, transorbital or endonasal route but primarily to expose the ipsilateral nerve. In this article, we describe the supraorbital keyhole approach to the contralateral medial optic nerve and tract, both in a series of cadaver dissections and in 2 patients. Indications and contraindications are discussed. Methods Cadaveric Dissection Bilateral supraorbital keyhole craniotomies were performed through an eyebrow incision in 3 preserved latex-injected heads to evaluate the extent of contralateral medial optic nerve visualization and decompression on each side, for a total of 6 optic nerves. We first performed a supraorbital keyhole craniotomy on the left side. Following durotomy, the frontal lobe was retracted to expose the bilateral optic nerves and the chiasm Fig. Next, the medial optic canals were decompressed using a high-speed drill, microcurettes, and rongeurs. A 1-cm portion of the orbital roof was removed bilaterally Fig. Cadaveric dissection demonstrating a supraorbital keyhole craniotomy: The left optic nerve black A and right optic nerve black B are shown in each image Aâ€”D. Supraorbital left-sided keyhole approach with the dura opened and frontal lobe retracted to expose bilateral optic nerves and the optic chiasm. A high-speed drill and an assortment of microcurettes and rongeurs were used to decompress the medial optic canal on both sides, and 1 cm of the orbital roof was removed bilaterally. Note the injury to the left optic nerve from retraction and the absence of the vasa nervorum, compared with the right side. Supraorbital keyhole craniotomy on the right side in the same cadaver. The optic nerves and the chiasm are now visualized from the contralateral right side. Again, note the absence of the vasa nervorum on the left side A. Extended medial decompression of the left optic nerve was performed from the contralateral right side. Note the circumferential decompression of the left optic nerve A and the extent of medial optic nerve decompression. An additional 5 mm of decompression was achieved using the contralateral approach. The second step was to perform a supraorbital keyhole craniotomy on the right side in the same cadaver. The optic nerves and chiasm were now visualized from the contralateral right side. The extent of medial optic nerve decompression was noted on both sides Fig. Next, an extended medial decompression of the left optic nerve was carried out from the contralateral right side Fig. Surgical Technique In each patient the positioning and approach was as follows: The orbital rim was also removed. The dura was gently elevated from the orbit. Extradural drilling of the orbital roof was performed under microscopic visualization. The dura was then opened in a C-shaped fashion and draped over the orbit. Progressive dissection and retraction of the frontal lobe allowed identification of the ipsilateral optic nerve. Dissection was then performed contralaterally to expose the contralateral medical optic nerve and chiasm. The medial optic canal was drilled out, as needed, to reach the pathology in one patient Case 1 , and in the other Case 2 , the lamina terminalis was opened to reach the medial contralateral optic tract. Once the pathology was resected, watertight dural closure was performed using Nurolon suture. The orbital bar and the craniotomy bone flap were affixed to the cranium using a low-profile plating system. Bone cement was used to smooth out any protuberances and fill in the defects between the bones. The scalp was approximated with Vicryl sutures, and a 5. The Prolene suture was removed 1 week postsurgery. Results In comparing the left versus the right supraorbital approach, the medial portion of the optic nerve was much better visualized from the contralateral side in all cadavers Fig. While we were able to perform bilateral medial optic nerve decompression of up to 1 cm from a unilateral craniotomy, the risk of retraction-induced injury to the ipsilateral optic nerve was higher than it was for the contralateral side, where no retraction was required. Similarly, the risk of iatrogenic vasa nervorum injury from the drill and curettes was significantly higher when decompressing the medial aspect of the optic nerve from the ipsilateral side compared with from the contralateral side. Figure 1C shows the medial decompression of a nerve Nerve A when performed from the ipsilateral sideâ€"note the absence of the vasa nervorum. Figure 1B shows the medial decompression of another nerve Nerve B when performed from the contralateral sideâ€"note the presence of the vasa nervorum. The ipsilateral approach to the optic nerve allowed for proximal superomedial decompression. However, avoiding any injury to the optic nerve itself or to its vasculatureâ€"the vasa nervorumâ€"was difficult to achieve from this route. As the decompression was carried away distally and inferiorly, the tangential view of the optic nerve prohibited further safe dissection and drilling. When approached contralaterally, the previous decompression was revealed to be circumferentially and longitudinally incomplete in all specimens Fig. The extensive medial view of the contralateral optic nerve enabled us to extend the previous decompression by approximately 5 mm in all specimens Fig. The depth of the surgical field was increased during contralateral procedures but did not significantly impede microsurgical maneuverability. Clinical Case Examples We present 2 clinical examples in which a contralateral supraorbital keyhole approach was used to treat a lesion medial to the optic nerve and tract, a prechiasmatic lesion in Cases 1 and a postchiasmatic lesion in Case 2. Case 1 A year-old woman presented with progressive visual deterioration 7 years after undergoing a pterional approach for the resection of a left sphenoid wing meningioma. She had noticed a visual deterioration in her left eye over the course of a year, which prompted her primary care physician to request an MRI scan. Contrast-enhanced MRI revealed a recurrence of the meningioma, which compressed the medial aspect of the optic nerve on the left side, anterior to the chiasm Fig. Preoperative, intraoperative, and postoperative images. Gadolinium-enhanced MR images demonstrating the recurrent meningioma on the medial aspect of the optic nerve on the left side, anterior to the chiasm, compressing the nerve. Intraoperative photograph revealing the meningioma on the medial aspect of the left optic nerve prior to its entering the optic canal on the left side. Intraoperative photograph after safely removing the lesion from the left optic nerve. Postoperative coronal and axial Gd-enhanced MR images showing gross-total resection of the lesion. A contralateral right-side supraorbital keyhole craniotomy was performed. The lesion was seen on the medial aspect of the left optic nerve, prior to its entry into the optic canal Fig. The lesion was safely removed Fig. The roof of the optic canal was also drilled away to further decompress the nerve as it entered the orbit. Postoperative MRI showed a gross-total resection Fig. Her vision stabilized after surgery. This indicated stability compared with her preoperative examination. She had no radiographic recurrence at the 3-month follow-up. Case 2 A year-old man had undergone an expanded endonasal resection of a craniopharyngioma that was performed by the senior author T. The patient did well postoperatively, with his vision markedly improved. However, 2 months after this surgery, he developed progressively worsening vision in his left eye. Visual field testing showed the following: MRI revealed interval development of a small hemorrhagic cyst with a fluid level compressing the chiasm and left optic tract Fig. Coronal Gd-enhanced MR image showing a cyst compressing the left optic tract. Sagittal MR image illustrating the fluid level in the cyst compressing the left optic tract. A contralateral right-side supraorbital keyhole craniotomy was performed to approach the lesion. The lesion was seen on the superomedial aspect of the left optic tract, under the lamina terminalis, posterior to the chiasm. Intraoperative image after resection of the lesion. Note the opening in the lamina terminalis, posterior to the chiasm. The left optic tract is decompressed. Postoperative coronal and sagittal contrast-enhanced MR images showing gross-total resection. A contralateral right-sided supraorbital keyhole craniotomy was performed. The lesion was seen on the superomedial aspect of the left optic tract, inferior to the lamina terminalis and posterior to the chiasm Fig. The lamina terminalis was opened posterior to the chiasm and the lesion resected, decompressing the left optic tract Fig. Postoperative MRI showed a gross-total resection of the lesion Fig. Postoperative visual field testing showed a remarkable improvement in vision: Discussion Optic nerve decompression is a crucial step for visual function outcome when treating various pathologies, 5 , 9â€"11 , 18 , 19 , 22 whether it is done through a transcranial, transorbital, or endoscopic endonasal route. Our study demonstrates that, for optic canal approaches, the contralateral keyhole exposure provides better visualization of the medial optic canal, while the ipsilateral corridor offers only a tangential and partially obstructed view Fig. Schematic of ipsilateral orange arrow and contralateral blue arrow supraorbital keyhole corridors. The contralateral approach allows better control of the medial wall of the optic canal, while the ipsilateral route offers only a tangential view hashed arrow. Of note is the medial optic canal, where successful endoscopic decompression has been performed for traumatic, infectious, and neoplastic optic lesions. In addition, if the lesion extends lateral to the anterior clinoid, it will not be amenable to resection through the endonasal route, while the contralateral keyhole approach will still be applicable. If the goal were to expose the medial aspect of both optic nerves, then a subfrontal approach would be appropriate. However, if the goal is to approach only the medial aspect of one nerve, then the contralateral keyhole approach is more suitable. There are 3 major limitations of the subfrontal approach: If one endorses the keyhole concept of minimally invasive neurosurgeryâ€”that patients will fare better with smaller openings and less brain retractionâ€”then the subfrontal approach is overly aggressive for unilateral medial optic nerve pathology. The direct exposure of the medial wall of the optic canal through the contralateral approach also eliminates the need for anterior clinoid process drilling, as it is often the case during ipsilateral approaches. Careful patient selection is mandatory. Evaluation should include assessment of the anterior communicating artery complex and the position of the optic chiasm. Conclusions In selected cases, a contralateral supraorbital keyhole approach can be used to safely and effectively decompress the superior and medial optic canal and should be the preferred surgical approach.

2: Minimally Invasive Brain Surgery | Keyhole Craniotomy | Brain Tumor Center

Axel Perneczky introduced this minimally invasive concept in formerly published book, "Keyhole concept in Neurosurgery", in Now, he renews and updates the minimally invasive concepts for various cranial approaches and presents in this book.

Learn About Different Keyhole Approaches: Supraorbital Eyebrow Approach The supraorbital eyebrow approach is useful for many patients with meningiomas, craniopharyngiomas and other tumors near the optic nerves and pituitary gland, as well as gliomas and metastatic brain tumors in the frontal and temporal lobes. This versatile, minimally invasive approach minimizes normal tissue disruption and brain retraction, allowing for a more direct approach to these lesions. Occasionally, an abdominal fat graft may be necessary to seal large nasal sinus defects. This approach is typically performed with the assistance of an endoscope, allowing for further visualization. As such, patients recover well and have good cosmetic outcomes long term. At the Pacific Brain Tumor Center, we have extensive experience with this approach, helping pioneer this operation since its introduction. We have published extensively on this topic. Typically, this operation is assisted with endoscopic visualization, allowing for increased visualization of the structures in the region. Patients recover relatively quickly in comparison with traditional pterional operations, with potentially less pain, chewing difficulties and facial muscle atrophy. Retromastoid Approach behind the ear The retromastoid approach also known as the retrosigmoid approach uses a small window behind the ear to reach and remove acoustic and trigeminal schwannomas, meningiomas, epidermoid tumors, and tumors of the cerebellum such as hemangioblastomas and metastatic brain tumors. It is also the main approach for microvascular decompression of the cranial nerves for trigeminal neuralgia or hemifacial spasm. This operation is augmented with the introduction of the endoscope, allowing for visualization around corners, limiting the need for extensive tissue removal or brain retraction. Occasionally, an abdominal fat graft is necessary to seal the opening and prevent a cerebrospinal fluid CSF leak. Overall, this operation is associated with great access to the pathology with minimal cosmetic or soft-tissue damage and relatively quick patient recovery. The gravity-assisted Trans-Falcine approach is ideal for the resection of meningiomas, gliomas astrocytomas, ependymomas, oligodendrogliomas, intraventricular tumors and metastatic brain tumors. The angled endoscopes allow for excellent visualization and the potential of maximal safe tumor resection. Compared to traditional approaches, patients have a relatively quicker recovery and the potential of increased preservation of neurological function. Trans-Tentorial Approach This approach takes advantage of the normal structures separating the cerebral cortex from the other structures of the hindbrain and brainstem, minimizing the need for brain retraction. The gravity-assisted trans-tentorial approach is ideal for patients with certain pineal tumors and cysts, gliomas, metastatic tumors and cerebral cavernous malformations of the inferior-medial posterior temporal and occipital lobes. The operation is performed in a sitting position to achieve this relaxation. Patients will require a pre-operative cardiac evaluation to ensure safe surgical outcomes. This procedure is performed endoscopically, allowing for improved visualization and a smaller craniotomy. Compared with other approaches, this has less risk to the occipital lobes vision processing region and decreased disruption of normal tissue and brain. Challenging deep-seated brain tumors and blood clots can be reached while minimizing the risk of damaging the surrounding dense and delicate neural structures that control brain and body functions.

3: Keyhole Neurosurgery | Â» Spinal Surgery

A. Perneczky and R. Reisch, in collaboration with M. Tschabitscher, offer a detailed systematic overview of the different approaches for minimally invasive craniotomies.

4: Keyhole Approaches in Neurosurgery. Volume 1 : Concepts and surgical technique

KEYHOLE APPROACHES IN NEUROSURGERY pdf

The atlas is a continuation of the previous works Endoscopic Anatomy for Neurosurgery and Keyhole Concept in Neurosurgery presenting the operative technical description of the different keyhole approaches based on surgical anatomical examples.

5: Supraorbital Craniotomy | The Neurosurgical Atlas, by Aaron Cohen-Gadol, M.D.

Why choose Keyhole Neurosurgery Neurosurgery is one of the most complex and intricate forms of surgery. We minimise the stresses endured by patients undergoing a neurosurgical procedure by utilising a Minimally Invasive Approach whenever possible.

6: Keyhole Neurosurgery | Minimally Invasive Neurosurgery

Enormous technological developments within and around modern neurosurgery, such as highly sophisticated preoperative imaging of the individual pathoanatomical situation, tailored planning of the operative procedure, routine application of neuronavigation devices and the intraoperative use of endoscopies, have enabled neurosurgeons to perform limited keyhole approaches, minimizing the.

7: Editorial: The supraorbital â€œkeyholeâ€• approach : Journal of Neurosurgery JNS

The clear benefit of keyhole neurosurgery is the minimal approach-related traumatization. By choosing the best approach to a specific lesion, the size of the craniotomy can be dramatically reduced with the need for only a small dura opening, with less brain exposure and retraction (2, 5).

8: Minimally Invasive Keyhole Brain Surgery | Robert Louis, MD

The keyhole concept in neurosurgery is designed to minimize the craniotomy needed for the access route to deep intracranial pathologies. Such keyhole surgeries cause less trauma and can be less invasive than conventional surgical techniques. Among the various types of keyhole mini-craniotomy.

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